

Light-emitting diode (LED) cap lamp research

Dr. John Sammarco, P.E.



Why Mine Illumination?

It's Fundamental for Safety

- **Miners depend on lighting to see mine hazards and work safely**
- **80% of our perception is visual**



Research Objectives

Reduce traumatic injuries

- Slips/Trips/Falls (STFs)
- Pinning/Striking
- Age-Related Injuries

Better lighting to help:

- Miners escape
- Rescuers



Miner Cap Lamp

Most important light source



- Traditionally incandescent light
- Now light-emitting diode (LED)



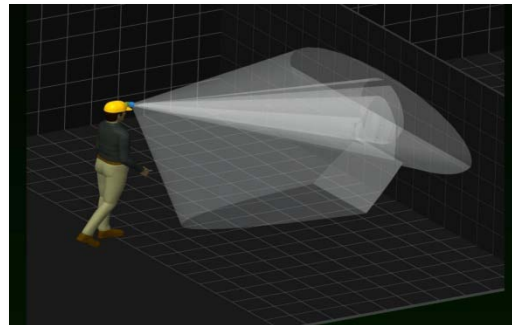
Presentation focuses on NIOSH LED cap lamp developments to improve safety.



Older worker issues



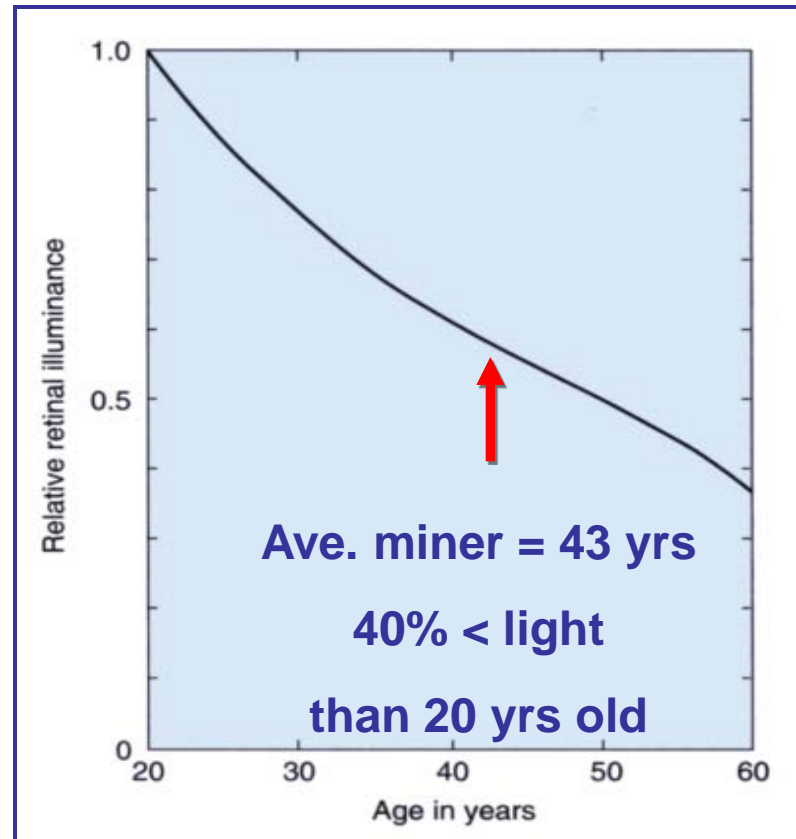
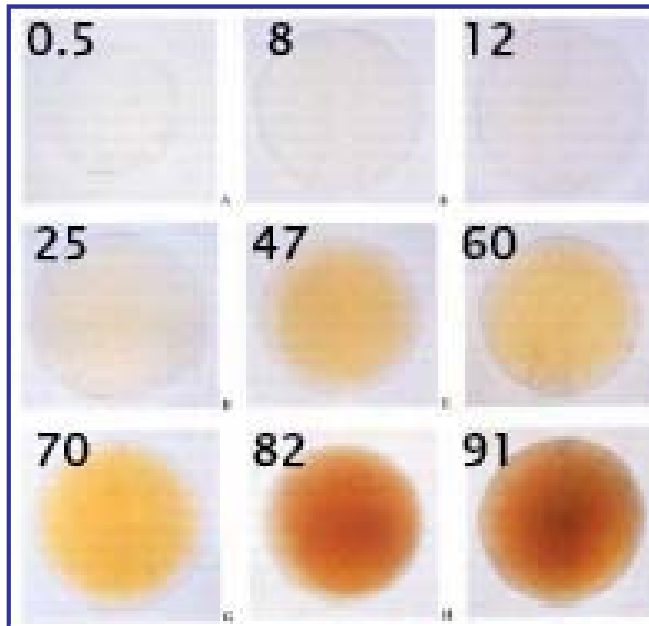
Light color



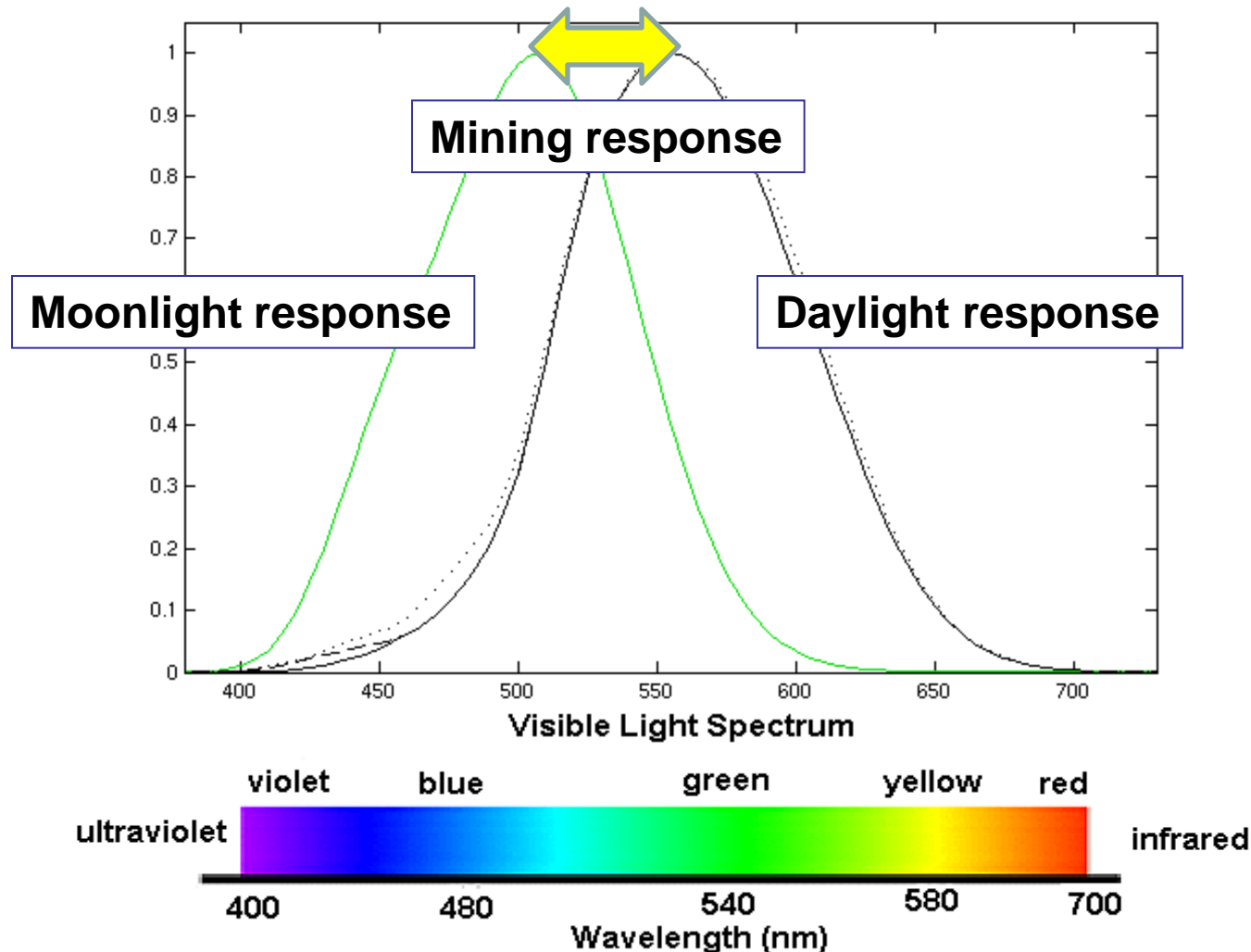
**Lighting pattern
(light the hazards)**

Older workers

Eye lens yellowing (age in years)

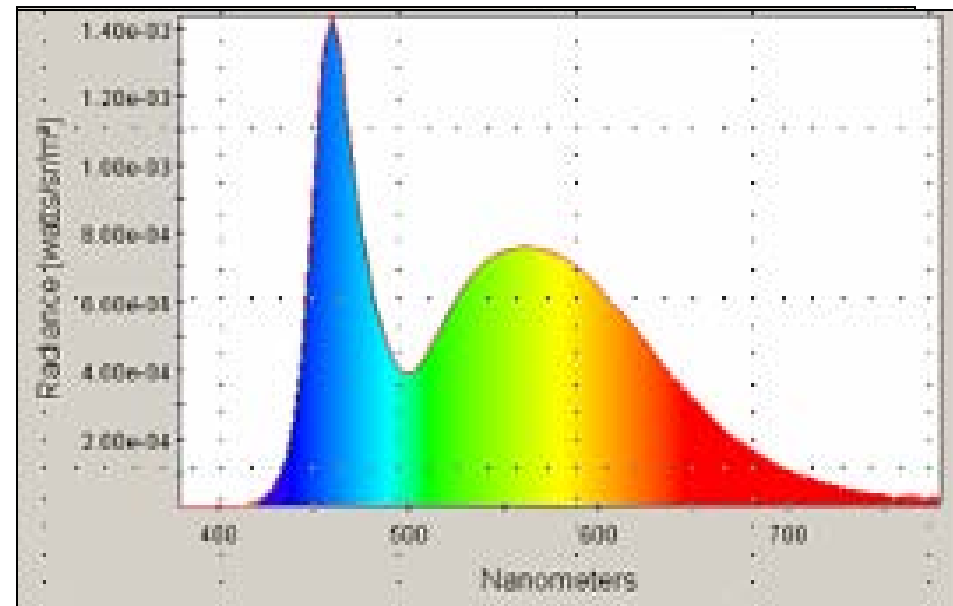
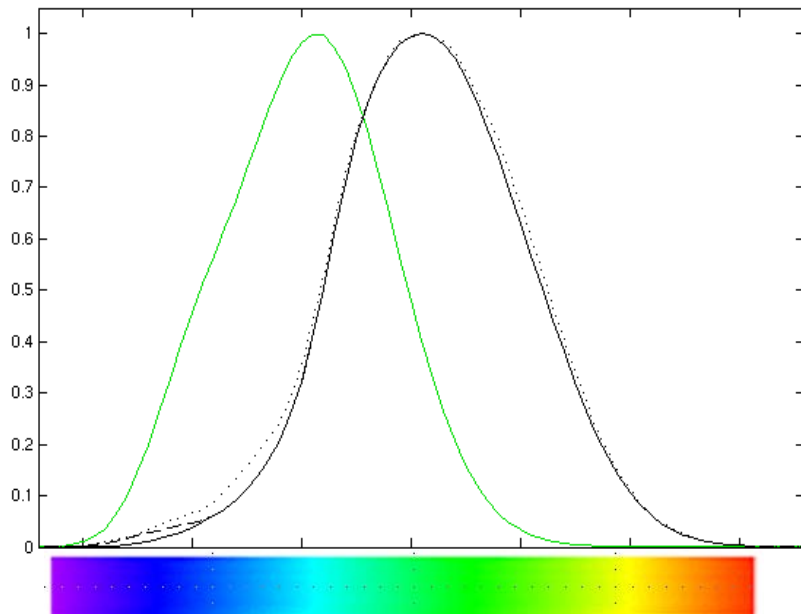


Light color is important for visual performance



Improve visual performance with light color

“Tune” color for eye sensitivity at mesopic conditions



NIOSH LED

1st NIOSH LED Cap Lamp



- 53.8% reduced glare
- 15% better peripheral detection ¹
- 23.7% better floor hazard detection ¹
- 65% less power than incandescent cap lamp

¹ Tests results indicated superior performance compared to other LED and incandescent cap lamps for test subjects over 50 yrs old.

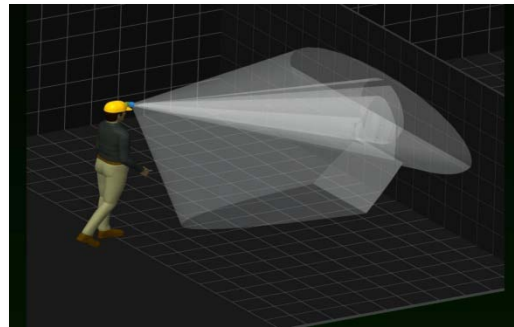
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Older worker issues



Light color



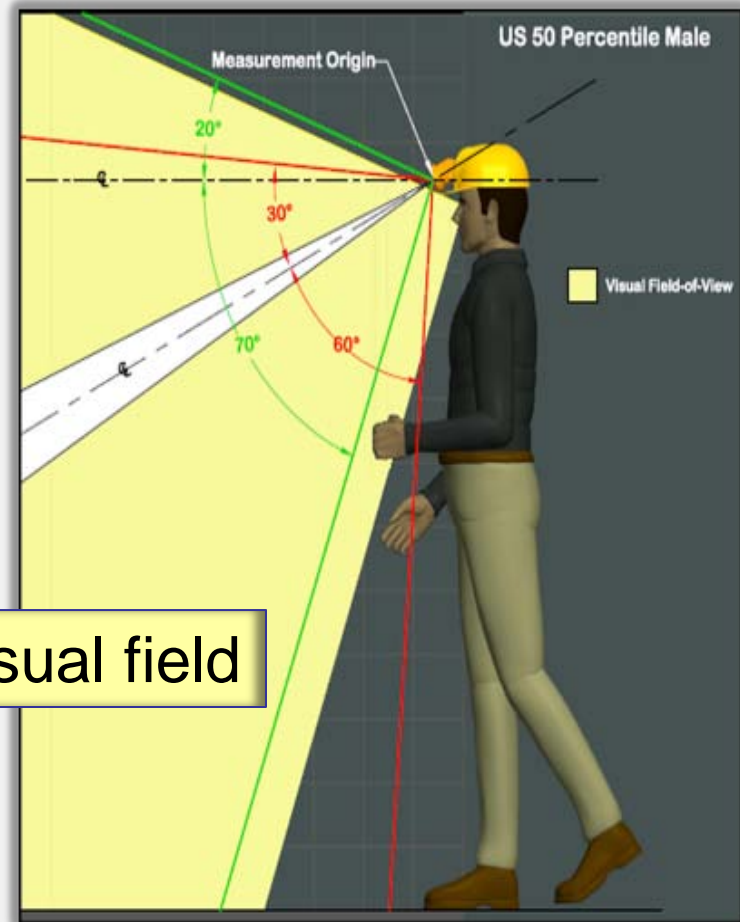
**Lighting pattern
(light the hazards)**

Cap Lamp Issues

1. Need to light hazards
2. One size fits all issue

Spot light pattern

Large visual field



NIOSH LED cap lamp vs. Commercial LED cap lamp

Commercial



NIOSH



33% - 50% less power than other LED cap lamps
79% faster peripheral detection
194% faster floor hazard detection
No glare issues

One size fits all issue

Visual needs vary given:

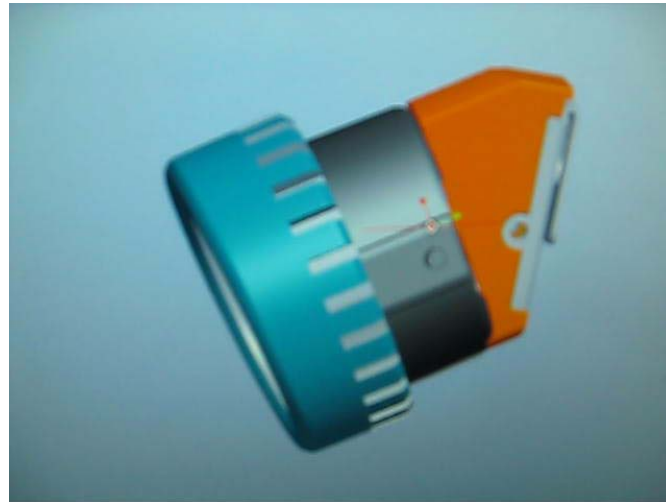
- the task
- conditions

NIOSH cap lamp:

- Programmable
- User selects light for task



What's next?



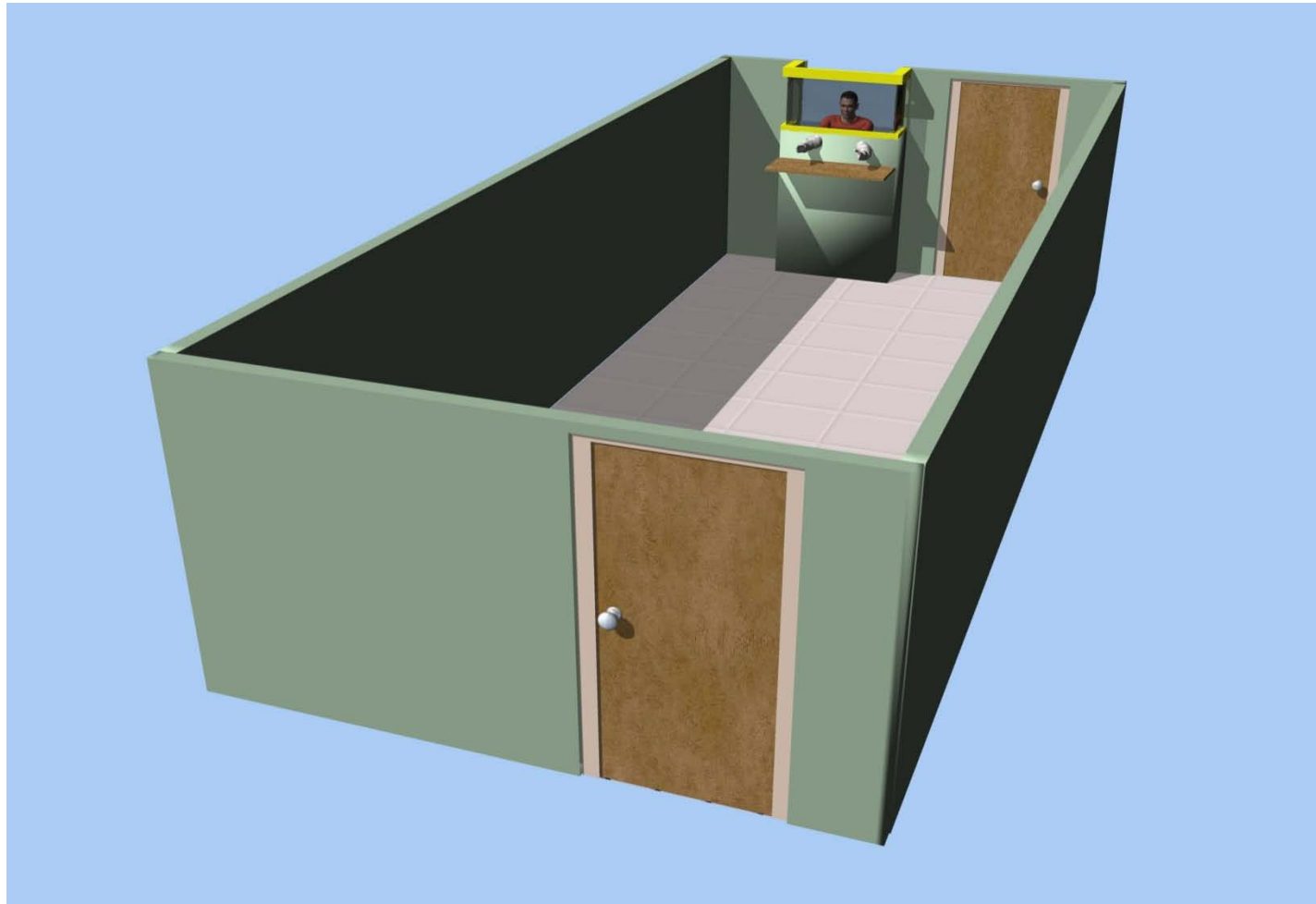
Emergency lighting

Objective: Optimal lighting for smoke escape/rescue?

Status: Human subject tests March 2011



Smoke Chamber



Colored ceiling tags mark primary escapeways



- **Best color?**
- **Better light pattern?**
- **LED better than incandescent?**



Floor rail track detection

Subjects to detect rail moving towards them



The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of NIOSH. Mention of company names or products does not constitute endorsement by the Centers for Disease Control and Prevention.



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The Office of Mine Safety and Health Research is a division of the National Institute for Occupational Safety and Health (NIOSH) www.cdc.gov/niosh/mining

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